A Comprehensive Study of Issues Affecting Poverty and Inequality in Brazil

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A Comprehensive Study of Issues Affecting Poverty and Inequality in Brazil

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SUMMARY

Brazil is a country that is considered an anomaly among many economist and political scientist because of its unique social, political and economic structure. Due to this fact, many of the rules that apply when analyzing developing countries do not necessarily apply to Brazil. For this reason, in the following chapters this paper will seek to dissect several distinctive issues that affect poverty and inequality in Brazil. Particularly, I have gathered information from various academic and data sources to provide a comprehensive picture of the true socio-economic situation in Brazil.

I focus on the most prominent issues affecting poverty and inequality in Brazil and use econometric and analytical techniques to construct each chapter. There are FOUR chapters, the first being an econometric paper that uses econometric techniques on a national household survey to tease out which factors having the largest influence on determining the incidence of poverty in Brazil's population. The second chapter provides the economic framework needed to discover the effect of land expropriation (a fairly recent constitutional amendment which allows squatters to acquire ownership of unused land) on poverty reduction. The third chapter analyzes the link between foreign direct investment and the trickledown effect on inequality. FINALLY, the fourth chapter develops an economic cost benefit analysis of one of the World Bank's Millennium Development Goals, providing clean water and sanitation, this chapter discusses its particular application to favellas in Sao Paulo, Brazil. (Finally, the fifth chapter is a discussion of the linkages between poverty and drug trafficking and poverty in Brazil and how policy decisions can affect this situation.)

This paper will touch on a wide range of topics affecting poverty and inequality in Brazil. In addition, this paper uses several different analytical techniques throughout each chapter to demonstrate how different economic methodologies can be appropriately used, and provides some discussion of the merit and difficulty with each.

1 DETERMINANTS OF POVERTY

1.1 INTRODUCTION

Brazil has shown reasonable levels of economic development however, this has not done much to decrease the amount of poverty in many regions in Brazil. By many social indicators, such as poverty and income inequality, Brazil ranks much lower than it should given its economic standing. This paper seeks to find the characteristics that determine poverty in Brazil. By utilizing the Linear Probability Model to analyze PNAD household survey data we find that there are indeed several factors that have a significant correlation in determining poverty in Brazil.

1.2 LITERATURE REVIEW

There have been many studies on the effects of poverty, much of which has been completed by the World Bank. The story of poverty in Brazil is a unique case in the material because of the high rates of inequality and the heterogeneity of the poor's level of income, human resources, and physical resources (Vener 2004).

There are several different factors that affect poverty in Brazil, although all cannot be covered empirically in this paper, a brief discussion can highlight some main issues. There are two main demographic characteristics that may affect the degree of poverty in a society. These two characteristics are the volume and distribution of resources and the distribution of the population in the households (Vener 2004). The first factor has direct implications on the endowments available to a particular group. In the particular case of Brazil, this factor may help to explain the widespread poverty amongst the rural citizens.

The second factor affects the labor market by determining the distribution of the population and family consumption variables. It seems plausible to assume that macroeconomic policies can have a dramatic effect on poverty. These macroeconomic policies have a direct effect on the two aforementioned factors via means such as redistribution of endowments or labor market standards.

The main characteristics cited as affecting poverty in Brazil are changes in economic activity and macroeconomic stability, reduction in the fertility rate and increased urbanization rate (Fiess 2004). This paper will seek to use econometric tools to account for the household characteristics that are correlated with poverty in Brazil.

1.3 CONCEPTUAL FRAMEWORK

This paper will use standard Linear Probability Model as the econometric techniques. This type of analysis allows us to use multiple linear regression to explain a qualitative event. The beta coefficient in the LPM model measures the change in probability of success when the independent variables changes, holding other factors fixed. The mechanics for this OLS regression is similar to the standard model.

1.4 EMPIRICAL METHOD AND ESTIMATION

$$
\begin{aligned}
&Poverty = \beta_0 + \beta_1 Age + B_3 Agesq + \beta_4 Fem + \beta_4 Black \\
&\beta_{5t} Mulatto + \beta_{1t} Rural_t + \beta_{2t} FamSize + \beta_{4t} FamSizeSq + \\
&\beta_{10} FamMem\_5 + \beta_{2t} FamMem\_5-15 + B_{3t} FamMem\_65 + \beta_{4t} School2 + \beta_{4t} School3 + \\
&\beta_{2t} School4 + B_{3t} Cart + \beta_{4t} Agri + \beta_{4t} Serv + \beta_{4t} Indu + \\
&\beta_{4t} Public + \mu_t
\end{aligned}
$$

1.4.1 VARIABLES

The measurement for poverty is given as part of the PNAD dataset. The two variables that I used to compare the analysis were the range of income and also the monthly income for the head of household. The range of income provides a set of dummy variables for each wage distribution in Brazil, poverty levels includes all ranges that are less than $5000 raels in 1989 dollars. I also created a dummy variable for individuals who had a monthly income of less than $5000 rael in 1989 dollars. This value is a measure used by the PNAD to determine the lower echelon's of the income distribution, thus it serves as an accurate measurement for poverty. On the other hand, it does not account for the efficiency of spending in these poor households. Testing will be required to ensure that the proper measure of poverty are used. There are different levels of variation and reporting for each of the poverty variables listed above.

The rest of the variables used are also dummy variables with the given descriptions below. Thus, for each of the household characteristics listed below there will be an associated dummy variable for each type of instance. The graph below gives an accurate description of the components of each variable as acquired from the PNAD household characteristics survey.

Table 1.1: Household Characteristics (HC)

Gender	Race	Age	Household	Location
Male	White	<25	No. < 5	Rural
Female	Black	25-45	No. 5-15	Urban
	Mulatto	45-65	No. > 65	
	Indig	>65		
	Asian			

Working Class	Work Sector	Tenure	Literate	Education
Active	Agrigculture	<1 yr	Yes	no educ
Worked	Industrial	>1 yr	No	1-4 yrs
	Service	1-3 yrs		4-8 yrs
	Social	3-5 yrs		8-12 yrs
	Public	>5 yrs		more than 12yrs
	Other			
Water Supply	**Sanitation**	**Electricity**	**Media**	
Piped	Sew Sys and Septic Tank	Yes	Yes	
not piped	Septic Tank 2	No	No	
NA	Rudiment Cespit			
	Drain			
	River/Lake			
	Other			
	NA			

For brevity in the model, the household characteristics only list the dummy variables group headings. In essence, to find the correlation between each of these variables and poverty, it is necessary to utilize the listed dummy variables to represent to case in which a certain attribute is true. Of this list under each sub-heading one of the variables will be selected as the dummy variable in the regression. The dummy variables are self-explanatory, but will be expounded upon in the results section as the correlation with poverty is examined.

1.5 DATA DESCRIPTION

The above data was gathered from the Pesquisa Nacional por Amostra de Domicilos (PNAD)- National Brazilian household survey. This is a yearly survey instituted in Brazil, the data is collected from interviews in rural and urban areas. The criticism of this dataset is that because of the difficulty in contacting people in rural sectors, the rural sector may be over reported and consequently the urban sector is under reported. This issue could potentially cause a bias in the data, however to perform my analysis we will assume that there is no bias present.

The biggest issue with the use of this dataset is that it is entirely published in Portuguese, thus creating a language barrier. In addition, there is heterogeneity amongst different regions in Brazil and this analysis does not account for regional differences. This issue will be taken into consideration, but can be considered in a later review. The number of observations does serve as a great benefit in this analysis because there are over 30,000 survey observations.

1.6 RESULTS

I did in fact find very interesting results from my analysis. I performed several different regression analyses to find which held significance for my model. Because I utilized survey data I found that some responses only had a limited number of responses despite the large dataset. The most significant regression analysis is shown in the graph below.

```
. reg poor_inc  age agesq young fem white urban famsize famsizsq fam_5 fam65 elem argic
```

Source	SS	df	MS		
Model	5089.62006	12	424.135005	Number of obs	= 65481
Residual	11186.4382	65468	.170868793	F(12, 65468)	= 2482.23
				Prob > F	= 0.0000
Total	16276.0582	65480	.248565336	R-squared	= 0.3127
				Adj R-squared	= 0.3126
				Root MSE	= .41336

poor_inc	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
age	.0006839	.000062	11.03	0.000	.0005624	.0008054
agesq	-7.37e-07	8.31e-08	-8.86	0.000	-9.00e-07	-5.74e-07
young	-.1468289	.0048382	-30.35	0.000	-.1563117	-.1373461
fem	-.2607946	.004023	-64.83	0.000	-.2686798	-.2529095
white	-.0922683	.0034219	-26.96	0.000	-.0989753	-.0855613
urban	.1402353	.0043727	32.07	0.000	.1316648	.1488057
famsize	-.0744761	.0027815	-26.78	0.000	-.0799279	-.0690243
famsizsq	.0042581	.000231	18.43	0.000	.0038053	.0047109
fam_5	-.4940109	.0065476	-75.45	0.000	-.5068442	-.4811776
fam65	.1487277	.0074342	20.01	0.000	.1341567	.1632988
elem	-.2249063	.0035788	-62.84	0.000	-.2319208	-.2178918
argic	.1210463	.0069935	17.31	0.000	.107339	.1347536
_cons	.9799042	.0106508	92.00	0.000	.9590286	1.00078

Figure 1.1: Regression Results

From the regression I found that all the variables were highly significant in the analysis and this model explains approximately 31% of the variation in poverty in Brazil. There were some issues however because the some of the variables were not correlated in the expected direction. The graph below shows the anticipated vs. actual sign of the model.

Variable	Actual	Intuition
age	0.0006	+
agesq	-7.37e_07	-
young	-0.1468	+
fem	-0.2608	-
White	-0.0923	-
Urban	0.1402	+
famsize	-0.0744	+
famsizesq	0.0043	+
fam_5	-0.494	+
fam65	0.1487	+
Elem	-0.2249	-
Agric	0.121	+

Figure 1.2: Regression Summary

Here we see that the variable young, which measures people under the age of 25, would be expected to have a positive correlation with poverty. A possible explanation for this result may be that the heads of household under 25 are more flexible to adapting with the economic market and thus are not as affected by poverty. The variables famsize and fam_5 represent the number of people in the family and the number of children under 5 in the family respectively. There may be some possible misspecification which caused the sign of the variable to be incorrect. There also may be other factors which are not accounted for in the model.

1.6.1 LIMITATIONS

The limitation of the model may include the fact that the poverty measurement used cannot account for transfers from people who are less poor to those who are at a much lower level of poverty. In addition as mentioned before, there may be issues due to national heterogeneity as well as the availability of data for certain variables.

1.7 CONCLUSION

In conclusion, the Head of household Characteristics act in the predicted manner for most variables in determining poverty. This implies that social programs can in fact be used to address these feature that would be beneficial to reducing poverty. This analysis also implies that an agricultural tax break could be used to produce beneficial results because it is significant in this analysis.

The next steps of this analysis would include doing a comparative study for each region. Also, getting access to surveys for several years would allow me to turn this analysis in to panel data. A panel data set would be more robust, thus allowing the data to show trends over time. Another possible extension of this model would be to include other less obvious variables to find unique relationships in the data.

2 LAND EXPROPRIATION

2.1 INTRODUCTION

The topic of fair land usage has been a pressing issue in Brazil for the latter part of the last century and up to today. Brazil has topped the charts on many measures of inequality and land ownership is no exception. Despite Brazil's progressive constitutional clause that allows for large and unproductive areas to be expropriated as part of agrarian reform, Brazil has a huge proportion of land owned by a small group of people. This paper will seek to discover how these tendencies have affected the income disparity in Brazil as well as the implications of land expropriation on poverty. Depending on the data available I may increase the specificity of my paper to a particular area in Brazil.

2.2 LITERATURE REVIEW

The relevant literature on land expropriation and the economic divide in Brazil seem to converge at a central point. Although, the process of land reform in Brazil has been uneven, subjective and subject to hot controversy, there is a deep need to provide access to land to decrease the amount of rural poverty in Brazil. There are several key papers that will set the background for my empirical work on this topic.

There is a substantial background for understanding the development of the current economic divide in Brazil. It has been argued that globalization and serving the whims of the international community served as a major factor in increasing inequality (World Bank 2000). During the 1930's Brazil actually had a relatively closed economy, which had the effect of developing organized sections of the urban community, but also neglecting the rural sector. Once the Brazilian economy was re-opened to international

trade in the 1960's, there were improvements in price and access to goods. However, globalization had a detrimental effect on the country's industry and these failures led to cuts in the public sector and extremely high inflation rates. Subsequently Brazil's Gini index, a measure of income inequality, is currently one of the highest in the world. To combat the inequality seen in the distribution of land and to increase land use efficiency, the government instituted land reform amendments to the constitution. These amendments allowed unused land to be transferred to the poor who wish to utilize the land.

There are three factors in the 1990's that led the growth of this movement: 1.) Neoliberal restructuring of the agricultural sector, 2.) Shift to urban-based government and 3.) Protestor violence (Ondetti 2006). The increased attention in the agricultural sector, domestically and internationally, caused the government to make faulty promises about the expropriation of land. One of the most important features of the landless movement in Brazil is the role of the MST (Movimento dos Trabalbadores Rurais Sem Terra) in Brazil's bottom-up land reform. The MST had a militant grass roots strategy of determining "unproductive" land and organizing citizen occupation of that land. This had the effect of driving the government to intervene via court rulings to officially expropriate the land. The effect of MST continues to reach new heights as a driving force in meetings with INCRA (National Institute for Colonization Reform) to determine land reform policies. Currently the MST has helped to over a million people gain legal rights to over 8 million acres of land reform settlements.

New programs such as CONTAG (National Confederation of Agricultural Workers), who offer financing packages and other forms of assistance to agrarian families provide an optimistic view of new developments in reform programs. The four factors that will determine the sustainability of these reform programs are: decentralized

implementation; a community based approach; access to investments; and ongoing piloting and evaluation (Roumani 2004). Growth statistics, especially in the agricultural sectors, suggest a market-based, community led mechanism is the best method for settling rural families.

Other characteristics of common land reform policies offer a different opinion on the role of the market in land reform. For instance, the different types of land reform are rights, security, structure, egalitarianism, gender, compensation, process and macroeconomic environment (Boyce 2005). The macroeconomic environment is arguably the most important type of land reform because land redistribution in the presence of exchange rate overvaluation and poor trade policies would only serve to increase the debt of the poor. In relation to poverty reduction in Brazil, "Family farms account for 40% of the total national value of production, while occupying just 30% of agricultural land area." (Boyce 2005) Small farms have also been shown to have higher output than large farms due to higher cultivation and cropping intensity, higher-value crop mix and higher yields per acre.

Because the poor need credit to get access to land, and land to get access to credit, it creates a difficult obstacle to entering the market to begin with. In addition, land ownership has a huge impact on political power, tying the elite to their land to maintain stature. Boyce argues that "Efforts to promote 'market-assisted land reform' by earmarking credit for land purchases for small farmers often founder on this stumbling block. It seems safe to conclude that rental markets and tenancy do not provide the proper incentives to reduce rural poverty or increase land productivity.

Opinions about the role of land reform policies diverge after the take off of the landless movement. Land expropriation has actually been described as providing

incentives for violence between squatters and land owners (Alston 2000). Land reform issues in Brazil such as INCRA's inconsistent policies and loop-holes that impair both squatter's rights and land owners via easily manipulated court procedures, tax burdens and lengthy and expensive appeals. The instability of this government organization has also been illustrated by the 19 INCRA heads in a 6 year period in the 1990's as well as mentions of corruption. The rise in conflicts can be attributed to the number of squatters, whether the land is cleared, concentration, settlements, land value and credit. These conflicts and the effect of land reform on accelerating deforestation also reduce the benefits of land expropriation policies.

2.2.1 ACADEMIC CONTRIBUTION

From a thorough analysis of the literature presented, I have found a large body of work that discusses the implications of the land expropriation on reducing rural poverty, a critical area of importance in Brazil. However, the majority of the aforementioned papers are theoretical in nature, describing the situation and drawing some assumptions. The contribution I intend to make to this body of literature is to apply empirical knowledge to the matter and establish a validation for some of these assumptions. I would like to look at historical data to find whether certain land reform programs did in fact help to alleviate rural poverty, while controlling for other external factors that could potentially affected changes. I intend for my input to help guide the evaluation of programs that seek to eradicate rural poverty in Brazil and other areas throughout the world.

2.3 ECONOMIC METHODOLOGY AND DISCUSSION

Because of the temporal ordering of this data, special considerations must be made when choosing the proper analysis method. The Ordinary Least Squares

Regression provides several useful properties for this analysis. Thus the parameters in this regression model all must satisfy the finite sample properties under classical assumptions. These assumptions include linearity in parameters, no perfect co linearity and zero conditional mean. These assumptions are relatively self-explanatory so there will be no further discussion of each; but it is important to note that under these three assumptions we can guarantee that the estimators in this regression model are unbiased. The theorem of unbiased estimators is very important because it allows us to take the estimates as is. There would be some work needed to prove the remaining to Gauss-Markov assumptions (no serial correlation and homoskedasticity) which would then prove that the model is a best linear unbiased estimator. Luckily there are further tools available to account for weakening these assumptions.

The OLS regression provides a simple and easy to understand empirical analysis of the dependent and independent variables. There is no reason to assume that there will be systematic biases in the data however, such as situation is possible. In such a case, it may be advisable to then seek other techniques as options. However, at this point the data does seem to satisfy the necessary conditions to be deemed unbiased. There is also the possibility of simply revamping the OLS model to accommodate any bias in the data versus using any other instrument which may not be as intuitive.

The empirical model below combines the most significant factors in reducing the land related poverty in Brazil. The hypothesis: Land expropriation has a significant impact on reducing poverty in Brazil, is easily tested with dummy variables that indicate policy reforms and robust controls. The empirical model as well as regression may need modification in the future, but do seem a promising way to analyze this problem.

2.3.1 EMPIRICAL MODEL

$$PI_t = HCI_t or PGI_t or GI_t or MLD_t or SPG_t$$

$$PI_t = \beta_{0t} + \beta_{1t} landreform_t + \beta_{2t} RuralPop_t + B_{3t} UrbanPop_t + \beta_{4t} ArableLand_t + \beta_{5t} IrrigatedLand_t + \beta_{6t} LandGini_t + \varepsilon_t$$

This paper will use standard Ordinary Least Squares econometric techniques. Utilizing a robust data set will assist the process of finding significant correlation between the independent and dependent variables of interest. Dummy Variables and sensitivity analysis will be an important feature of this study.

2.3.2 VARIABLES EXPLANATION

Poverty/Distribution Indicators (PI):

- Household in Poverty (HIP)
    - Number of households in the population with consumption or income per person below the poverty line.
- Rich Poor Ratio (RP)
    - The 20% richest citizens of the population versus the 40% poorest.
- Gini Index (GI)
    - A measure of inequality between 0 (everyone has the same income) and 100 (richest person has all the income).
- Theil Index(TI)
    - The weighted sum of inequality within subgroups

Land reform will be a dummy variable to indicate whether the Land Reform and Poverty Alleviation Project in 1998, also known as Cedula da Terra, is in action. Although this program was initially piloted for Northeast Brazil it expanded throughout all of Brazil. Thus, it should represent the beginning of new land reform policies.

The population variables are controls to factor out population growth in Brazil as a potential source for measurement error. It was also important to delineate between rural, urban and total population to see if one portion of the population affects the Poverty Indicators more substantially. Under the same token, arable and irrigated land was also included in the regression. There may prove to be the necessity of lagging more than one of the independent variables to account for persistence and inertia in land-holding and poverty.

There also may need to be further deliberation to decide if there should be a variable included for the quality of the arable or irrigated land, the land being available for use does not directly imply that it is viable for farming activities. A possible way to include such a variable would be to account for technology, which would have an affect on the productivity and returns to the land available. However, there would also be secondary effects including a possible correlation between technology decreasing rural employment due to new inefficiencies and thus increasing the urban poor. Unfortunately, such an analysis would be very complicated and out of the scope of this paper.

Finally, the land Gini Index depicts the distribution of land in Brazil. This variable will be very important because I anticipate that it will show that as the land is distributed more equally in Brazil, so to is the income. Thus, I would hope to see a strong positive correlation between these two variables.

2.3.3 DATA SOURCES

The above data will be gathered from a variety of sources including:

1. The World Bank Brazilian Profile
2. Desenvolvimento Humano no Brasil (DHB)

3. FAOData
4. IPEAData
5. IMF World Indicators

There was in fact a wide range in the availability and range of the data. The multiple datasets listed above were in fact combined to form the final dataset. Although, the majority of the data covered the period from 1970 to 2001 there was data that included points from the 1950's. However, because of missing data and the range of other significant variables I chose to utilize the results from the period beginning in 1970 only. This did have the affect of limiting the amount of data available, however it would be difficult to perform any meaningful analysis while including these missing variables.

2.3.4 LIMITATIONS

Testing will be required to ensure that the proper measures of poverty are used. There are different levels of variation and reporting for each of the poverty variables listed above. There are issues involved with several of the poverty indicator variables, for instance, HCI equally weights each person below the poverty line, although as was previously mentioned there are very heterogeneous levels of poverty in Brazil. PGI does differentiate for levels of poverty, however it cannot account for the transfers of income within the poor population. The different poverty indicators will also provide a robust sensitivity analysis for the data.

Another limitation regards the dataset because a large portion is only published in Portuguese, thus creating a language barrier. In addition, although most of the data is available on the national level, there is heterogeneity amongst different regions in Brazil. This would not be major cause for concern, except for the availability issues of data

variables on the local scale. Thus this study is limited to a national review, which may serve to bias the results.

Other considerations in the limitations of this model include the possible necessity of restricting the model to increase the significance of the variables. The difficulty finding significance may extend from my use of time-series data, which serves to limit the amount of observations available for use. Although this approach may facilitate finding statistical significance, omitting variables may also cause bias due to the lack of inclusion of all economically significant factors. One potential solution is to find regional data to create a cross-sectional analysis and also provide a more robust data set.

2.3.5 EXPECTATIONS

The direction of the relationships in this regression has been well documented in the literature. There have been studies that analyze the effects of each of these independent variables both jointly and alone. From the literature and a preliminary analysis of the data, I would expect the land reform dummy variable to have a negative and significant relationship with several of the Poverty Indicators. This would be expected because the policies were enacted to reduce poverty and inequality; the main new finding would be the coefficient which determines the impact of land reform policies. I expect that increases in urban and rural population will be strongly and positively correlated with income inequality due to limited resources and historical evidence. The amount of arable and irrigated land available may turn out to be insignificant variables, however they will be important controls in this analysis. Finally, I anticipate the Land Gini variable to be strongly and positively correlated with poverty and inequality because it represents a specific type of inequality. Thus as poor Brazilians have increased access to land, I would expect to see their economic conditions improve. If this is the

case, then it would seem reasonable to draw the conclusion that the expropriation of land played an important factor in poverty reduction and income redistribution in Brazil.

2.4 PRELIMINARY RESULTS

Preliminary regression results are contained in the STATA log file found in the Appendix. An important control variable, LandGini Index is missing from the data which may serve to bias the data as well as make some of the other independent variables insignificant. Several different authors have cited Klaus, Deininger and Heng-fu Zou and the Food and Agricultural Organization of the United Nations as the source of the LandGini Index for Brazil, however upon further inspection and several inquiries I have been unable to obtain the data. A possible substitute would be variables for land holdings by size; however it does not necessarily indicate who controls the holdings. The preliminary results did find significance for population and land type variables, although not in the predicted direction. The preliminary results do indicate that further specification will be needed.

2.5 CONCLUSION

In conclusion, I propose that with an increased access to data and perhaps further specification of the model, it will be straightforward to show that land expropriation has played a significant role in reducing rural and urban poverty in Brazil. Reduction in rural poverty is of great importance because it can also be a key to providing an incentive to reduce the urban poverty in Brazil as well. The mass shift of workers and families from rural to urban poor causes a host of ramifications, mainly exacerbating inequality issues. Land reform policies that have an impact on alleviating poverty and inequality have been and will be continued to be studied in Brazil and

countries of the like. This report should provide a useful empirical framework to match the countless theoretical and social papers that have been completed on the matter.

3 FOREIGN INVESTMENT

3.1 INTRODUCTION

Brazil has one of the highest levels of social and economic inequity in the world. As a result, one of the nation's major policy issues has been whether to focus on national or international development. International forces have had a strong effect on Brazilian economics since the invasion of the Portuguese in the 1500's. The Portuguese introduced the sugar, gold and coffee markets to Brazil (Schwartzman, 2003) as well as the slave trade. This trafficking of Africans forever changed the landscape of Brazilian culture and created the largest population of blacks, outside of Africa, in the world.

After World War II Brazil began playing a much less dominant role in international economics by following an isolationist policy and using import substitution. Weary of becoming a victim of economic underdevelopment in the global economy, Brazil focused on developing their own modern industries. It was felt, in fact, that "The struggle for economic development and against poverty should be a struggle against the alliance of local oligarchies and foreign investment." (Schwartzman, 2003) This philosophy was both a gift and curse to Brazil. Their isolationist policy allowed local businesses to thrive without the forces of external competition; however, it also created an environment that would permit inequality to thrive.

The magnitude of the development in the new modern cities could only be matched by the magnitude of the growth in poverty around the rest of Brazil. The industrial areas were well funded and employees in this sector had many of the assurances accustomed to American employees such as job tenure, retirement planning and health care access. The rural poor, on the other hand, were completely left out of

the equation and survived mostly on subsistence farming and hard work for little pay. These conditions caused a huge migration of the impoverished populations to the city; however, lacking the skills to compete within the modern cities, the amount of urban poverty grew. Several other factors including rising inflation led Brazil to abandon its isolationist policies.

With the election of President Collor, the country began to once again open its borders to the international market. The country experienced short term gains in terms of increased consumption options and decreased costs. The mismanagement of this process caused long term problems with industries within the country as well as a decrease in public services, further exacerbating poverty issues in Brazil. The policies that ensued in the following decade, with respect to Foreign Direct Investment, also fueled the economic divide in Brazil. Corruption spread throughout the Brazilian government and eventually led to Collor's impeachment.

Inequity has played a huge factor as an inhibitor in Brazil's growth and development. Although Brazil has conquered many of its economic hurdles, it is still not up to par on the social front. According to the 1997 Gini Index, which measures income inequality in a particular country, Brazil has one of the highest levels of inequality in the world. According to the Brazilian National Household Survey, the richest 1% of the nation has a higher income than the poorest 50% of the country. That vast disparity took a long period of time and several detrimental government policies to become a reality.

As aforementioned, Foreign Direct Investment played an important role in creating the economic divide in Brazil. Foreign Direct Investment can be described as a long-term investment by a foreign direct investor in an enterprise resident in an economy other than that in which the foreign direct investor is based.

To form a strong correlation between levels of FDI and the income distribution, I will also require data on the poverty rates and Gini Index values in Brazil, again over a period of 20+ years. I plan on utilizing the resources of Dr. Usha Nair-Reichert to help form a complete and significant empirical model. I will also review the findings of other researchers via scholarly databases such as EconLit, NBER, etc.

I hypothesize that Foreign Direct Investment had a negative impact on the income distribution in Brazil. It seems plausible that the surge in development in the urban sectors in Brazil did cause a huge initial gain in growth for the country. However, due to the abundance of cheap, unskilled labor in the rural areas and the migration of a large portion of this population to the urban sector, the wages did not allow for this new found prosperity to trickle down to the poorest of the country. I will seek to show that the objectives and actions of foreign investors directly contributed to widening the economic divide in Brazil.

The main question asked by the majority of literature available is whether FDI has a significant and/or positive affect on poverty reduction. There are several ways to measure the impact of FDI on poverty alleviation. Such mechanisms include: Economic growth, knowledge spillover, tax spending and forward and backward linkages (Calvo and Hernandez 2006). Social indicators can also be a useful tool in analyzing the impact of FDI on a developing country (Tambunan 2003).

Finding the direct impact of FDI on poverty alleviation is of great importance. There has been a hot debate among country leaders centered around whether the "trickle down effect" of economic growth obtained from FDI will actually improve the economic situation of the poor; or will dependence on foreign investment crowd out local business and hinder the labor force. Brazil is of special importance because of several

features that will be discussed in further detail throughout this paper. The implications of this data can help to align incentives for foreign companies to invest with benefits to the impoverished in Brazil. These findings could also help to direct FDI in sectors that could most benefit the poor or setting wage/employment requirements to more directly affect them.

3.2 LITERATURE REVIEW

Because the effect of FDI on a particular country is very heterogeneous, it is of great importance to be able to discern which factors determine the ramifications of FDI with respect to the poor. A relationship that has been pointed out is that FDI tends to have a significant positive impact on growth; and in turn growth has a positive impact on poverty reduction (Tambunan 2003). The poor are said to benefit from such growth due to increases in wages and employment, decrease in the price of goods, and higher tax revenue spent on social programs (Calvo and Hernandez 2006).

However, in the particular case of Brazil there are particular background situations that work in favor and also against these hypotheses. For instance, one study finds that increases in economic growth serve to exacerbate problems in countries with wide economic gaps, as is the case in Brazil (Timmer 1997). In addition, it has been found that FDI is most effective in countries where there is and adequate levels of education and infrastructure (Klien, Aaron and Hadjimichael 2001). A sign that the poor of a country may be left out of the economic growth can be attributed to urban and education premium paid by multinational firms. FDI has also been mentioned as a less volatile form of capital (Klien, Aaron and Hadjimichael 2001), but empirical evidence supports this finding in most countries, excluding Brazil. The Economic Commission for

Latin America found that at a time when FDI in Brazil was at its highest level, during the 1990's, the unemployment rate raised three fold! Clearly, there are policy issues or special circumstances in Brazil that cause it to break the mold when it comes to the impact of FDI.

Although there has been extensive work done on the role of FDI on an aggregate or macro-level, it would serve as an important finding to analyze the particular situation in Brazil. In addition, using social and industry data will be a new method of analyzing the impact of FDI in a robust nature.

3.3 EMPIRICAL MODEL

$$DI_t = HCI_t or PGI_t or GI_t or MLD_t or SPG_t$$

$$DI_t = \beta_{0t} + \beta_{1t} FDI_t + \beta_{2t} GDP_t + B_{3t} LitRate + \beta_{4t} Pop_t + \beta_{5t} Unemp_t + B_{6t} ArgEmp + \beta_{7t} ServEmp_t + \beta_{8t} IndusEmp_t + \mu_t$$

3.3.1 VARIABLES

Social Indicators (SI):

- Average per capita GDP (GDP)
- Literacy Rate
- Population

Distribution Indicators (DI):

- Household in Poverty (HIP)
    - Number of households in the population with consumption or income per person below the poverty line.
- Rich Poor Ratio (RP)
    - The 20% richest citizens of the population versus the 40% poorest.
- Gini Index (GI)
    - A measure of inequality between 0 (everyone has the same income) and 100 (richest person has all the income).
- Theil Index(TI)
    - The weighted sum of inequality within subgroups

Industry Indicators (II):

- Unemployment level (Unemp)
- Agricultural Employment (Agremp)
- Industry Employment (Indusemp)

- Service Employment (Servemp)

3.3.2 VARIABLE CHOICE

The above variables are chosen to analyze different perspectives of the affect of FDI on the poor. The Social Indicators seek to find a more qualitative analysis how the rate of FDI affects the characteristics of Brazilian citizens. This would be helpful to illustrate any incentives FDI may have on the population to improve their current situation. Distribution Indicators is choice of inequality indicators which will be determined by analyzing their significance. Finally, Industry Indicators will allow the ability to differentiate the effects of growth on different industries. From this information it can be determined which section of the population benefits most.

3.3.3 MAGNITUDE AND DIRECTION OF EFFECT

It is expected that SI will have a small positive correlation because of increases in the labor market, however there are several exogenous variables that may not be accounted in this model. I anticipate DI will have a positive correlation that is larger in magnitude than the SI. This is due to considering the current situation in Brazil and its historical situations. Finally, I anticipate that there will be a significant correlation between the level of FDI in a particular industry and poverty levels.

3.3.4 ECONOMETRIC TECHNIQUE USED

This paper will use standard Ordinary Least Squares econometric techniques. Utilizing a robust data set will assist the process of finding significant relationship between the independent and dependent variables of interest.

3.3.5 DATA SOURCES

The above data will be gathered from a variety of sources including:

1. The World Bank Brazilian Profile
2. IPEA Data (Brazilian economic and regional database)
3. IMF World Indicators
4. 1970, 1980, 1990, 2000 Brazilian Census

There was in fact a wide range in the availability and range of the data. The multiple datasets listed above were in fact combined to form the final dataset. Although, the majority of the data covered the period from 1970 to 2001 there was data that included points from the 1950's. However, because of missing data and the range of other significant variables I chose to utilize the results from the period beginning in 1970 only. This did have the affect of limiting the amount of data available, however it would be difficult to perform any meaningful analysis while including these variables.

3.4 RESULTS

The regression results below were obtained from utilizing STATA software to analyze the collected data. The use of Ordinary Least Square is apparently the best method to capture the true relationship between these variables. Although this type of regression does not necessarily indicate causality, it does show a correlation among the variables that can be drawn upon to draw some conclusions.

The results from the Ordinary Least Square Regression were informative, however not as promising as I would have hoped. Because I used a time series

regression this limited the amount of data points to include with the regression and generally ran from 15-30 observations. In addition, the small number of observations had the effect of limiting the number of control variables used in the model. From Table 1 and 2 we can see that the best models included GINI(1) and THEIL(1). Both models included FDI, CGDP, LITRATE, and POP as dependent variables. The R-squared values were .5706 and .689 for GINI and THEIL respectively, indicating that using the THEIL index represents a better-fit for the data.

3.4.1 GINI INDEX

In analysis, the Gini Index is the standard measure used to account for income inequality within or across countries. The main advantage of the Gini Index is that is uses ratio's to account for inequality which is a unit-less measure. One consideration in terms of this analysis is that if the Gini coefficient is rising as well as GDP, poverty may not be improving for the majority of the population, and here we do see a positive correlation.

The Gini Coefficient does satisfy the four important principles: anonymity, scale independence, population independence, and the transfer principle. However, there are concerns that a country that is more economically diverse will inherently have a higher gini coefficient. In addition, Gini may underestimate inequality because it doesn't measure how efficiently poor and rich households use their money.

Table 3.1: GINI Index Results

Standard OLS Regression
(t-statistics reported in parentheses)

	GINI (1)	GINI(2)	GINI(3)	GINI(4)
constant	5.67	-0.624844	-17.94926	.5634
	(4.82)	(-.12)	(-1.12)	(3.67)
fdi	-1.05E-12	-3.64E-13		4.84E-13
	(-1.95)	(-.76)		(.78)
cdgp	3.39E-05	0.000013		9.38E-6
	(2.68)	(0.76)		(.38)
litrate	-0.0996		-.0618815	
	(-4.21)		(-1.16)	
pop	1.92E-05	-1.52E-06		1.30E-7
	(3.81)	(-1.14)		(.06)
agremp		0.0301609		
		(0.21)		
indusemp		.0127197		
		(.26)		
servemp		.0160008		
		(.30)		
lnfdi			.0010699	
			(.19)	
lnpop			2.036116	
			(1.17)	
lncdgp			-.077934	
			(-.88)	
unemp				-.0073725
				(-1.28)
R-squared	0.5706	.5463	.1094	.4598
Adj. R-sqaured	0.4632	.3452	-.1133	.2936

From the OLS regression analysis we can see that the model GINI(1) is the best representation of the relationship between inequality, as measured by the Gini Index, and FDI. Per Capita GDP, LitRate and population were the most significant control variables in this analysis. Here they do behave as one would expect with the population and per capita GDP being associated with increasing inequality and the literacy rate decrasing poverty. The key variable of interest, FDI is actually shown to reduce inequality in a significant way. With these results in mind, I would conclude that my initial hypothesis was incorrect. The main reason why the other control variables failed

to have a significant impact is that there was a small amount of data available for this time series analysis.

```
. reg gini  fdi pop cgdp litrate
```

Source	SS	df	MS		
Model	.002657246	4	.00066431	Number of obs	21
Residual	.0019999	16	.000124994	F(4, 16)	5.31
				Prob > F	0.0064
Total	.004657146	20	.000232857	R-squared	0.5706
				Adj R-squared	0.4632
				Root MSE	.01118

gini	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
fdi	-1.05e-12	5.37e-13	-1.95	0.069	-2.19e-12	9.09e-14
pop	.0000192	5.05e-06	3.81	0.002	8.52e-06	.0000299
cgdp	.0000339	.0000127	2.68	0.017	7.05e-06	.0000608
litrate	-.0996491	.0236909	-4.21	0.001	-.1498717	-.0494266
_cons	5.679677	1.178941	4.82	0.000	3.180433	8.17892

Figure 3.1: Regression 1 Model

Looking at the regression results from model 1 we see that FDI is in fact weakly significant and inversely correlated with the gini index. Two control variables population (pop) and the literacy rate (litrate) are strongly significant with p-values of .002 and .001 respectively. The per capita GDP was also weakly significant showing a p-value of .017. Because the Gini Index does only range from 0 to 1 we see that the coefficients for each of the dependent variables seems very small. There is generally a limited amount of variation in the Gini Index for a specific country, thus although there is a small coefficient, a small change in the variation could lead to noticeably significant changes in the actual inequality observed in a country. As previously mentioned, the R-squared value is approximately .5706 indicating that this analysis explains about 57% of the variation seen in the Gini Index. This model is indeed a great starting place, however more work may need to be done to further, and accurately, specify the model.

3.4.2 THEIL INDEX

The Theil Index is not used as often as the Gini Index, but it does provide useful information, especially in the case ot this regression. The main advantage of the Theil index is that it is additive across different spatial regions in a country.

Theil's measure has all of the desirable properties of an inequality measure: it is symmetric, replication invariant, mean independent, and satisfies the transfer principle. The Theil index, however, does not have a straightforward representation and lacks the appealing interpretation of the Gini coefficient.

Table 3.2: THEIL Index Results

Standard OLS Regression
(t-statistics reported in parentheses)

	THEIL (1)	THEIL(2)	THEIL(3)
constant	23.85442	-9.364199	-37.65722
	(5.82)	(-.39)	(-.59)
fdi	-5.4E-12		
	(-2.91)		
cdgp	0.000104	.0000657	
	(2.37)	(.95)	
litrate	-0.45833	.0897224	
	(-5.56)	(.50)	
pop	0.000092	-.0000236	
	(5.24)	(-.66)	
agremp		.0509365	
		(.22)	
indusemp		.0625568	
		(.27)	
servemp		.0621723	
		(.26)	
lnfdi			-.0114434
			(-.51)
lnpop			4.317923
			(.62)
lncdgp			-.3855017
			(-1.09)
unemp			
R-squared	0.689	.5482	.1516
Adj. R-sqaured	0.6112	.2770	-.0605

Analyzing the THEIL(1) model exclusively, we find that FDI has a slight, but significant negative correlation with this measure of inequality. The other control variables are significant and do in fact behave as one would expect. Population and GDP per capita are both positively correlated with the THEIL measure of income inequality and the literacy rate is negatively correlated with income inequality. However, the R-squared value is relatively low, thus I would suggest that this model can be further specified when more data is available.

```
. reg theil  fdi pop cgdp litrate
```

Source	SS	df	MS		
Model	.053602906	4	.013400727	Number of obs =	21
Residual	.024198238	16	.00151239	F(4, 16) =	8.86
				Prob > F =	0.0006
Total	.077801144	20	.003890057	R-squared =	0.6890
				Adj R-squared =	0.6112
				Root MSE =	.03889

theil	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
fdi	-5.43e-12	1.87e-12	-2.91	0.010	-9.39e-12	-1.47e-12
pop	.000092	.0000176	5.24	0.000	.0000548	.0001293
cgdp	.0001044	.0000441	2.37	0.031	.0000109	.0001979
litrate	-.4583261	.0824081	-5.56	0.000	-.6330235	-.2836287
_cons	23.85442	4.100906	5.82	0.000	15.16088	32.54795

Figure 3.2: Regression 2 Model

Much like the previous Gini Index, looking at the regression results from model 1 we see that FDI is in fact weakly significant and inversely correlated with the Theil Index. Again the two control variables population (pop) and the literacy rate (litrate) are strongly significant here with p-values of .000 and .000 respectively. Again, the per capita GDP was also weakly significant showing a p-value of .031. The Theil Index also ranges from 0 to 1, so again we see that the coefficients for each of the dependent variables seems very small. The same explanation for the size of the coefficients applies here.

As previously mentioned, the R-squared value is approximately .689 indicating that this analysis explains about 68.9% of the variation seen in the Theil Index. Thus, considering the increase in significance of the dependent variables as well as the overall improvement in the goodness-of-fit for the Theil index, I would suggest that this is a more appropriate measure and model of correlation between FDI and Income inequality.

3.4.3 OTHER INDICES

Table 3.3: Other Indices Results

Standard OLS Regression
(t-stat reported in parentheses)

	HIP(1)	RP(1)
constant	5.05E+8	-79.78
	(0.82)	(-.58)
fdi	-0.00021	-6.05E-11
	(-.67)	(-.89)
cdgp	-10356.6	0.0038559
	(-1.44)	(2.4)
litrate	-1E+07	1.975972
	(-.83)	(-0.71)
pop	3027.9	-.0005574
	(1.08)	(-.89)
agremp		
indusemp		
servemp		
lnfdi		
lnpop		
lncdgp		
unemp		
R-squared	0.2227	0.6628
Adj. R-sqaured	0.0154	0.5729

The final two inequality indicators did not prove to be useful. The households in poverty measure (HIP) did not show any significant dependent variables, which may indicate that FDI does not necessarily have an effect on reducing the number of poor families because the wealth generated by FDI does not trickle down to the poorest of the population. However, such a conjecture would need further analysis to be proven.

The richest 20% versus poorest 40% ration did give an relatively good R-squared value, as it was comparable to the Gini and Theil Indices Analysis, however it failed to

attribute any significance to the dependent variables. For this reason, it is most likely not an effective model.

3.4.4 LIMITATIONS

Testing will be required to ensure that the proper measures of poverty are used. There are different levels of variation and reporting for each of the poverty variables listed above. In addition, there are issues involved with several of the poverty indicator variables, for instance, HIP equally weights each person below the poverty line, although as was previously mentioned there are very heterogeneous levels of poverty in Brazil. RP does differentiate for levels of poverty, however it cannot account for the transfers of income within the poor population. On the other hand, the different poverty indicators will also provide a robust sensitivity analysis for the data.

Another limitation regards the dataset is that a large portion is only published in Portuguese, thus creating a language barrier. In addition, although most of the data is available on the national level, there is heterogeneity amongst different regions in Brazil. This would not be major cause for concern, except for the availability issues of data variables on the local scale. Thus this study is limited to a national review, which may serve to bias the results.

3.5 POLICY IMPLICATIONS

Assuming this analysis is both valid and comprehensive this would be a signal to policy-makers to utilize the benefits of FDI to help improve the economic conditions in Brazil. A possible reason why FDI seems to be correlated with a decrease in income inequality is because it spawns job creation and economic growth in an economy. Many critics argue that FDI has issues trickling down the wealth to the employees and citizens who need the money the most, however this analysis shows that the FDI need only be focused more to enhance the benefits.

It has been noted that one of the most important effects of FDI is the increase in the wage inequality due to the way the labor market interacts with FDI. This is essentially because multinational firms tend to utilize more skilled labor as well as the benefits of spillover tended to benefit firms with higher technology. Because the majority of poverty occurs within rural and uneducated populations, it is imperative that programs are instituted to improve their social situation. Perhaps with the firms providing FDI also investing in improving the labor market in a given region.

Further analysis is suggested, in which case information on rural and urban population, the trade by GDP (openness) ratio, expenditure of government welfare programs and immigration. Including this type of information could provide more information about the specific direction of FDI in Brazil as well as how it is distributed throughout the country.

4 WATER AND SANITATION

4.1 INTRODUCTION

The purpose of this paper is to analyze the prospects of improving the current sanitation system in Brazil. According to Dr. Lee Jong-Wok, a Director General at the World Health Organization, "Water and Sanitation is one of the primary drivers of public health." she continues, "once we can secure access to clean water and to adequate sanitation facilities for all people, irrespective of the difference in their living conditions, a huge battle against all kinds of diseases will be won." Issues with sanitation have been linked to increased incidences of Diarrhea, Malaria, Schistosomiasis, Intestinal helminthes and Arsenic contamination.

This topic is such a pressing issue that the United Nations has identifies water supply, sanitation and hygiene in the Millennium Development Goals. Sanitation is an issue that affects many developing countries; my hope is that my analysis of the costs and benefits of implementing upgrades in Brazil will facilitate highlighting the importance of this pressing concern.

Sanitation is a pressing concern in developing nations around the world, affecting millions of people globally. However, due to the unique nature of each countries current sanitation conditions, each analysis may differ by country, or even by particular regions in a country. This paper will look at the cost/benefits of improving the sanitation system in Brazil. This will include looking at the different alternatives available to improve

access to clean water and sewage as well as subsequent improvements in the health of the Brazilian populace.

4.2 LITERATURE REVIEW

The literature on the matter of the benefits of sanitation improvements at the global level all come to a central consensus. Although some authors may differ over the scope of infrastructure development necessary to see a marked improvement in health and poverty reduction, all of the authors agree that access to clean water is a necessary basic need.

Despite the wide-ranging implications of improving water and sanitation resources, Brazil does not give much importance to this pressing issue. This is in part due to the fact that those who most desperately need access to water are neglected in the political arena. According to the United Nations, although the water coverage rates for Brazil are reported at 85%, this result is skewed because in Brazil, only the richest 20% of the population have complete access. People living in rural and slum areas on the other hand do not enjoy the same benefits. The same is true of sanitation resources in Brazil.

There were also differing ways of calculating the benefits of implementing projects for evaluating water and sanitation projects. For instance, one report included time savings associated with better access to water and sanitation facilities, the gain in productive time due to less time spent ill, health sector and patients costs saved due to less treatment of diarrhoeal diseases, and the value of prevented deaths (Hutton, 2004). Although all of these variables do in fact create a major benefit for the beneficiaries of

water and sanitation improvements, some of these variables are hard to measure and quantify.

As previously mentioned, the Hutton paper makes mention of the health benefits associated with improvements in water and sanitation. There are five different routes for pathogens to travel to humans via water. These five routes are as follows: water borne, water-washed, water-based, water-related vector-borne and finally water-dispersed infections. He measures the affect of intervention in a reduction of incident rates and mortality rates. This can be considered good estimates with figures that should be readily available for most countries. An important key to this analysis however, is defining an economic value for each of these elements.

Another published paper points out a complication to measuring the benefits of improvements in water and sanitation (Pedley, 2004). This is because the pathogens that cause water-related illness are evolving over time. Such pathogens are able to evolve and morph to adapt to new environments, technology and human resistance. Thus the current benefits of improvements in water and sanitation may not hold for future periods as the pathogens evolve over the same period of time.

In a book by M.F. Drummond, the author points out the complications of quantifying benefits to health. Using a cost Effectiveness Ratio, interventions would be measured in the most natural effects such as “life years gained” or “cases correctly diagnosed”. This is a better method for evaluating the health benefits for this analysis because as I mentioned in the introduction of this literature review, it is very difficult to quantify some of these effects. The author also makes mention of a method called cost-

consequence analysis that allow the decision maker to choose the relative importance of an output measure.

In a paper by Andrew Cotton of the World Health Organization provides a significant number of tools to assess the operation and management status of water supply and sanitation in developing countries. These tools can be used to measure and evaluate the effectiveness of the current water system in Brazil. These tools assess the following aspects: effectiveness, guidelines for audit, status assessment, performance evaluation, performance assessment, selection of performance indicators, performance indicators for water supply and sanitation, and potential information sources.

One of the most important tools for this analysis will be the performance indicator because it provides a method to choose the indicators most specific to Brazil's situation. For instance, one group of indicators in the tool is the level or service. The indicators are evaluated in terms of the data components, formula and how widely applicable it is.

4.3 MANAGEMENT SUMMARY

This paper will also assume that there are a number of direct and indirect benefits to different sectors such as health, consumers, agricultural and industrial. In addition, because the benefits in each of these sectors are long term, this paper will assume a discount rate to find the Net Present Value (NPV) of these improvements.

Due to the wide ranging effects of improving the water and sewage benefits of a particular area, one of the constraints of this cost benefit analysis will be the inability to

accurately describe all of the costs and benefits. This paper will, however seek to use the variables that provide this most overall significance to this analysis. Another significant constraint for this analysis will be the availability of data. The specificity of the report will be dependent on whether regional and local data is available.

4.3.1 METHODOLOGY

This will be an ex-ante study that draws data from Brazilian governmental sources. After evaluating factors for importance and measurability, the data will be identified as cost and benefits. This report will draw upon several other models to help evaluate the impact of improving the water/sanitation systems in Brazil. Then using the cost benefit ratio as the preferred method of evaluating the viability of alternatives, the best alternative will be selected.

4.3.2 COST AND BENEFITS EVALUATION CRITERIA

As previously mentioned, the alternatives will be evaluated based on the cost/benefit ratio. Due to the overwhelming interest in and resources available for improving water availability and sanitation in Brazil, cost alone will not be a major deciding factor. Also, due to the differing situations in Brazil, there will not be any evaluation based on the number of people affected by the improvements in water/sanitation. In short, the alternatives may have different benefits depending on location/technology available; this cost benefit ratio may be weighted to take this fact into account.

The benefits of this project will be evaluated by the improvements to health of residents in Sao Paulo, Brazil. These health benefits will be assumed as the direct benefits. In addition, there are a host of indirect benefits such as reduction of pollution, time saving, safety, and quality of life. The cost will be evaluated in terms of the cost of construction and developing infrastructure.

4.4 DESCRIPTION OF ALTERNATIVES

4.4.1 CURRENT SYSTEM

Currently in Brazil, access to adequate water and sanitation is seemingly well developed, unless you consider the case of the favella's, or shanty towns, and rural areas. In these areas residents lack even basic access to water and sanitation. In the case of the rural areas, there is no current system in place to provide water and sanitation service. Favella's on the other hand utilize a condominium model to provide water and sanitation services, which provides service to blocks of residences. Programs such as these cover all costs associated with connection, but residents are required to pay for rainwater drainage and typically fail to upkeep their end of maintenance of the system.

4.4.2 PROPOSED SYSTEM

The alternatives that this paper intends to evaluate cover the scope and scale of the implementation of sanitation and water upgrades in Brazil. The alternatives this paper will pursue include:

1.) Access for all to improved water and sanitation
2.) Access for all to improved water and sanitation plus household water treatment for point of use.
3.) Access for all to regulated in-house piped water and sewage connection.

4.5 DEMAND MODEL

A demand model to determine the probability of a household wanting to change their current water system needs to be determined to accurately decide the willingness to pay of residents. This demand model is adapted from the McFadden Discrete Choice Model for Household Preferences Options.

The water demand model assumes that a household is utility maximizing and must decide between using a new source and keeping their current source. For either choice the utility level (U) associated with each choice is based on monetary cost of obtaining water from that source (C), the perceived quality of water (V), household Income (Y), and socioeconomic proxies for family taste (Z). The model is formed as follow:

$$U_{ij} = \beta_0 + \beta_1 C_j + \beta_1 V_j + \beta_1 Y_i + \beta_1 Z_i + \mu_{ij}$$

Where i refers to a particular family and j is the choice of 1 or 2 for the current and new system. We then use the probability that a family will chose the new source over their current source. Thus, we intend to find the probability that the utility for the new source is higher than the utility for the old source. Algebraically:

$$P(Choice_i) = (U_{i1} - U_{i2}) > 0$$

The only significant assumption that may need to be made is that a subset of data is representative of a larger group of the population as surveys tend to be required for this type of utlity estimation.

4.6 COSTS

4.6.1 DEVELOPMENT COSTS

To analyze and measure the costs associated with upgrading the water and sanitation in Brazil, it is most effective to look at the incremental cost of upgrading

services to an additional individual in Sao Paulo Brazil. The investment costs include: planning and supervision, hardware, construction and house alteration, protection of water sources, and education that accompanies an investment in hardware. The World Bank's Global Water Supply and Sanitation Assessment 2000 Report gives the following estimates for per person investment costs.

Table 4.1: Investment Cost per Person

Water Improvement	**US $**
House Connection	144
Standpost	41
Borehole	55
Dug Well	48
Rain Water	36
Disinfection at Point of Use	.273
Sanitation Improvement	
Sewer Connection	160
Small Bore Sewer	112
Septic Tank	160
Pour-flush	60
VIP	52
Simple Pit Latrine	60

4.6.2 OPERATIONAL COSTS

Recurrent costs include: operating materials to provide a service, maintenance of hardware and replacement of parts, emptying of septic tanks and latrines, regulation and control of water supply, ongoing protection and monitoring of water sources, water treatment and distribution and continuous education services. The World Bank was also the source of estimates for these estimates. The costs here are shown as a percentage of the total investment costs.

Table 4.2: Estimation of Long Term Cost (Variation) as Percentage

Improvement	Length of Life in years (+ range)	Operation, Maintenance, Surveillance as % annual cost (+ range)	Education as % annual cost (+ range)	Water Source Protection as % annual cost + Range
Water Improvement				
House Connection	40 (30-50)	30		10 (5-15)
Standpost	20 (10-30)	5 (0-10)		10 (5-15)
Borehole	20 (10-30)	5 (0-10)		5 (0-10)
Dug Well	20 (10-30)	5 (0-10)		5 (0-10)
Rain Water	20 (10-30)	5 (0-10)		
Sanitation Improvement				
Sewer Connection	20 (10-30)	30 (15-45)	5 (0-10)	
Septic Tank	40 (30-50)	10 (0-10)	5 (0-10)	
VIP	30 (10-30)	5 (0-10)	5 (0-10)	
Simple Pit Latrine	20 (10-30)	5 (0-10)	5 (0-10)	

4.7 BENEFITS

4.7.1 RECURRING AND NON-RECURRING BENEFITS

There are several ways to evaluate the benefits for the water and sanitation improvements in Brazil. The main source of benefits for this analysis is evaluated by the number of lives that can be saved. In addition to health benefits there are benefits in terms of time and efficiency savings. As mentioned in the literature review, there are a significant number of health benefits. Improvements will help to decrease the number of water-borne, water-washed, water-based, water-related vector-borne and water-dispersed diseases. Thus improvements in water and sanitation decrease the odds of a person being affected by disease. The benefits of improvements will specifically be

measured by the value of the decrease in the incidence of death as measured by the value of a statistical life in Sao Palo Brazil.

4.7.2 NON-QUANTIFIABLE BENEFITS

The non-quantifiable benefits are wide-ranging and enhance the life saving and health benefits. The direct economic benefits of avoiding diarrhoeal disease and related time savings for the health sector and patient benefits. The health sector sees benefits such as a decrease in expenditure on water related diseases, whereas patients see benefits from reducing the costs for treatment, transport and time. The consumer also see benefits in terms of water collection and accessing sanitary facilities, labor saving devices in the household, raise in property value and increase in leisure time. Finally the industrial and agricultural sector will find benefits in terms of improved water supply, more efficient resources, and time-saving industry changes.

There are also indirect benefits related to health improvements. Improvements in water and sanitation would also decrease the number people that contract water related diseases from other related parties. In addition, there are benefits in terms of increased leisure and joy for individuals that see improvements in water and sanitation.

4.8 COMPARATIVE EFFECTIVENESS SUMMARY

Keeping in mind all the benefits highlighted earlier in this paper it straight forward to construct a cost benefit ratio for the costs of implementation versus the effectiveness as measured in terms of the value of the number of lives saved. The cost effectiveness

ratio provides the most effective decision based on a given measure of effectiveness. This can also be assumed to be a proxy for changes in the user utilities in this case.

The graphs below provide the initial constructs for the cost effectiveness ratio. As outlined in the cost and benefits sections of the report, the graph below shows the cost per person for water and sanitation combined and per person.

Table 4.3: Sanitation Cost per Person

Improved Sanitation	C (dollars per person)	C (dollars total)
Household Sewer Connection plus partial treatment of sewer	13.38	57286170.9
Septic Tank	12.39	53047508
VIP	5.84	25003829.5

Table 4.4: Water Cost per Person

Alternative Componenets	C (dollars per person)	C (dollars total)	Total Costs for water + Sani	E (Value of Saved Life)	Total Lives Saved	Total Value of Lives Saved
Improved Water Supply						
Regulated piped water in house	15.29	44798325.6	102084497	743	83488.8141	62032189
Standpost	3.17	9287815.06	62335323.1	549	83488.8141	45835359
Borehole	4.07	11924734.2	36928563.6	105	83488.8141	8766325

The alternatives for water and sanitation are as follows:

Alternative 1: VIP + Borehole

Alternative 2: Septic Tank + Standpost

Alternative 3: Household sewer connection plus partial treatment of sewer + Regulated piped water in house

Each of these alternatives will affect the same community in Sao Paulo, Brazil; i.e. those without access to water and sanitation. Each of these alternatives provides a different amount of value to the target population, thus the value provided by each alternative is given as the effectiveness of that particular alternative.

4.8.1 COST EFFECTIVENESS RATIO

The cost effectiveness ratio is shown below. Here we can see that all the alternatives provide benefits that are greater than no improvement of sanitation. The highest value of cost effectiveness, when compared to no intervention, was for Alternative 1, with a CE ratio of 4.21. The next best alternatives were Alternative 3 followed by alternative 2.

Comparing the alternatives to each other, we see that Alternative 3 is much more effective than alternative 2, however alternative 2 is less effective than alternative 1, with comparative cost effectiveness ratio's of 2.45 and .685 respectively.

Table 4.5: Cost Effectiveness Ratio

C/E (Relative to no Improvement)	S_j (basis for comparison)	deltaC (Relative to S_j)	deltaE (Relative to S_j)	deltaC/deltaE (Incremental cost-effectiveness ratio)
1.645669746	S2	39749173	16196829.93	2.454133
1.359983308	S1	25406759	37069033.46	0.68539
4.212547628				

4.8.2 **ADJUSTED COST EFFECTIVENESS RATIO**

To create a more robust analysis it was also effective to use an adjusted cost effectiveness ratio. The adjusted cost effectiveness ratio provides a medium between the cost effectiveness analysis and cost benefit analysis by including social benefits and costs in the estimates. The below social benefits are used to evaluate the adjusted cost effectiveness ratio. The social costs below are in addition to the costs listed previously.

Table 4.6: Social Cost and Benefits Associated with each Alternative

Social Benefits	3	4	5
Number of Diarrhoeal cases	0.1	0.52	0.7
Value of Days saved due to avoided lost work, school	31.752	165.1104	222.264
Annual Health sector treatment	1.92	9.75	13.16
treatment costs saved per capita	0.05	0.27	0.36
Total Savings	33.722	175.1304	235.784
Social Cost			
person receiving intervention	10	3	22

Taking the adjusted cost effectiveness ratio into account we find that the value of social benefits changes the ranking of the alternatives. The benefits from decreases in the number of diarrhea cases, value of days not missed, savings in the annual health sector and savings for treatment costs add substantial value to alternatives 2 and 3. With this in mind, one may conclude that alternative 3 is the best alternative because it ranks high in both the cost effectiveness and adjusted cost effectiveness ratios. However, it will be beneficial to perform a Monte-Carlo sensitivity analysis.

Table 4.7: Adjusted Cost Effectiveness Ratio

Adjusted CE Ratio	Alternative 1	Alternative 2	Alternative 3
Total Social Costs	19.91	18.56	50.67
Total Social Benefits	33.722	175.1304	235.784
Net Value	13.812	156.5704	185.114
Adjusted CE Ratio	0.131542857	0.285191985	0.249144011

4.8.3 MONTE CARLO SIMULATION

The graph below details the Monte-Carlo simulation for the cost effective analysis. The annual cost per year is evaluated at a four percent interest rate. In addition to the discount factor the simulation accounts for uncertainty in the model. The formulation of the Monte-Carlo simulation is shown below.

C/E Ratio in Sao Paulo Water and Sanitation Improvements

	Alternative 3		Aternative 2		Aternative 1	
	Value of Lives Saved	Cost $M	QALYS Saved	Cost $M	QALYS Saved	Cost $M
Year 1	62032188.87	102084496.5	45835358.94	62335323.09	8766325.48	36928563.61
Year 2	62032188.87	131119904.6	45835358.94	107924722.7	8766325.48	120929083.3
Year 3	62032188.87	131119904.6	45835358.94	107924722.7	8766325.48	120929083.3
Year 4	62032188.87	131119904.6	45835358.94	107924722.7	8766325.48	120929083.3

		C/E ($m per Q)		C/E ($M per Q)		C/E ($M per Q)
Part a: CE without Discounting	0	**2.00**		**2.11**		**11.40**
	0					
Part b: CE discounting only C	0.04	**1.88**		**1.97**		**2.11**
	0					
Part c: CE discounting C and E	0.04	**1.99**		**2.09**		**2.11**
(discounts used in Monte Carlos)	0.04					

Part d: Assuming full discounting

Uncertainty in E	Uncertainty in C
0.3	0.3

NOTE: New exercises can be constructed by changing program assumptions, discount rate, or levels of uncertainty.

Monte Carlo Trials (1000)	C/E Alternative A	C/E Alternative B	C/E Alternative C
	1.50	1.91	2.18
	2.48	2.45	2.89
	1.83	2.10	2.34
	2.08	2.30	1.68
	1.97	1.73	1.82
	2.05	2.46	1.60
	1.78	1.83	2.20
	2.08	1.61	1.83
	2.12	2.02	2.35

Figure 4.1: Monte Carlo Simulation

Here we find conclusive results that in the long run, and when also taking uncertainty into account, Alternative 1 or 2 provide the best long term return, both showing a mean CE Ratio of 2.12.

Table 4.8: Monte Carlo Simulation Results

Alternative 3		Alternative 2		Alternative 1	
Mean C/E	2.02	Mean C/E Alt B	2.12	Mean C/E Alt B	2.12
S.D. C/E	0.36	S.D. C/E	0.40	S.D. C/E	0.40
Minimum C/E	1.12	Minimum C/E	1.03	Minimum C/E	1.16
Maximum C/E	4.09	Maximum C/E	3.83	Maximum C/E	3.88

Taking all of the analysis into consideration, Alternative 2 appears to be the best option. Alternative 2 does provide substantial benefits in terms of health as well as social benefits. Thus a thorough analysis of the options, the best recommendation of this report is to utilize alternative 2 and provide septic tanks and standposts to the residents of Sao Paulo Brazil who currently have no access to water or sanitation.

5 CONCLUSIONS

In conclusion, Brazil has a tremendous amount of potential. Being one of the largest economies in the region gives them the opportunity to utilize its local, regional, national and international influence to counteract its socio-economic issues. Brazil's poor humanitarian ratings have been a major growth inhibitor and have caused issues with its reputation. If Brazil can tackle the issues relating to poverty and inequality such as the determinants, land equality, distribution of foreign direct investments, and water and sanitation upgrades, we will begin to see great improvements in the position in the international landscape.

APPENDIX

A. ECONOMETRICS DATA SNAPSHOT

This is a snapshot of the raw data and data codebook.

```
                    0201  01
)0005O1407060506                        000000501
706873161111605940049100030 6
  13090809                          999999999 988
     34                               2          2
370687336221200395603310004061121363114200000
l10688068706873328322605983006300 000
     12                                 2
)6870687336221211094104710005015
     07060509                                    988
383322211303936053100040 5
l0080711  000006000000006000000006004877782O4
       11080703  000000381000000381000000381 3
          1 112002 01028455722000314 4
68706870687336331221097701114040004
        06050411  000000381000000381000000381
```

VARI	NOME	DESDE	TAM	CO
	3 - COMUM MAIS DE UM			
	5 - NÃO TEM			
	9 - SEM DECLARAÇÃO			
	- NÃO APLICAVEL			
209	DESTINO DO LIXO	39	1	
	0 - COLETADO			
	2 - QUEIMADO			
	4 - ENTERRADO			
	6 - TERRENO BALDIO			
	8 - OUTRO			
	9 - SEM DECLARAÇÃO			
	- NÃO APLICAVEL			
210	ILUMINAÇÃO ELETRICA	40	1	
	1 - TEM			
	3 - NÃO TEM			
	9 - SEM DECLARAÇÃO			
	- NÃO APLICAVEL			
211	NUMERO DE COMODOS	41	2	
	1 - 1 COMODO			
	2 - 2 COMODOS			

B. INTERNATIONAL TRADE STATA LOG FILE

---

log: C:\Documents and Settings\gtg991g\Desktop\Int Econ.smcl

```
  log type:  smcl
. edit
- preserve

. clear

. edit
(51 vars, 37 obs pasted into editor)
- preserve

. Reg  gini  fdi cgdp lifeexpec litrate primed seced unemp
unrecognized command:  Reg not defined by Reg.ado
r(199);

. reg gini  fdi cgdp lifeexpec litrate primed seced unemp

      Source |       SS       df       MS              Number of obs =       3
-------------+------------------------------           F(  2,     0) =       .
       Model |  .000466668     2  .000233334           Prob > F      =       .
    Residual |           0     0           .           R-squared     =  1.0000
-------------+------------------------------           Adj R-squared =       .
       Total |  .000466668     2  .000233334           Root MSE      =       0

------------------------------------------------------------------------------
        gini |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         fdi |  -2.74e-11          .        .       .            .           .
        cgdp |  (dropped)
```

```
  lifeexpec |  (dropped)
    litrate |  (dropped)
     primed |  -5.68e-10          .       .       .           .          .
      seced |  (dropped)
      unemp |  (dropped)
      _cons |   .6535095          .       .       .           .          .
------------------------------------------------------------------------------

. reg  theil fdi cgdp lifeexpec litrate primed seced unemp

      Source |       SS       df       MS              Number of obs =       3
-------------+------------------------------           F(  2,     0) =       .
       Model |  .003074667     2  .001537334           Prob > F      =       .
    Residual |           0     0           .           R-squared     =  1.0000
-------------+------------------------------           Adj R-squared =       .
       Total |  .003074667     2  .001537334           Root MSE      =       0

------------------------------------------------------------------------------
      theil |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        fdi |  -7.58e-11          .       .       .           .          .
       cgdp |  (dropped)
  lifeexpec |  (dropped)
    litrate |  (dropped)
     primed |   2.81e-09          .       .       .           .          .
      seced |  (dropped)
      unemp |  (dropped)
      _cons |   .7666033          .       .       .           .          .
```

```
------------------------------------------------------------------------------

. reg gini  fdi pop cgdp litrate

      Source |       SS       df       MS              Number of obs =      21
-------------+------------------------------           F(  4,    16) =    5.31
       Model |  .002657246     4  .000664311            Prob > F      =  0.0064
    Residual |    .0019999    16  .000124994            R-squared     =  0.5706
-------------+------------------------------           Adj R-squared =  0.4632
       Total |  .004657146    20  .000232857            Root MSE      =  .01118

------------------------------------------------------------------------------
        gini |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         fdi |  -1.05e-12   5.37e-13    -1.95   0.069    -2.19e-12    9.09e-14
         pop |   .0000192   5.05e-06     3.81   0.002     8.52e-06    .0000299
        cgdp |   .0000339   .0000127     2.68   0.017     7.05e-06    .0000608
     litrate |  -.0996491   .0236909    -4.21   0.001    -.1498717   -.0494266
       _cons |   5.679677   1.178941     4.82   0.000     3.180433    8.17892
------------------------------------------------------------------------------

. reg theil  fdi pop cgdp litrate

      Source |       SS       df       MS              Number of obs =      21
-------------+------------------------------           F(  4,    16) =    8.86
       Model |  .053602906     4  .013400727            Prob > F      =  0.0006
    Residual |  .024198238    16   .00151239            R-squared     =  0.6890
-------------+------------------------------           Adj R-squared =  0.6112
```

```
      Total |  .077801144    20  .003890057          Root MSE      =  .03889

------------------------------------------------------------------------------
      theil |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        fdi |  -5.43e-12   1.87e-12    -2.91   0.010    -9.39e-12   -1.47e-12
        pop |    .000092   .0000176     5.24   0.000     .0000548    .0001293
       cgdp |   .0001044   .0000441     2.37   0.031     .0000109    .0001979
    litrate |  -.4583261   .0824081    -5.56   0.000    -.6330235   -.2836287
      _cons |   23.85442   4.100906     5.82   0.000     15.16088    32.54795
------------------------------------------------------------------------------

. reg  householdsinpoverty fdi pop cgdp litrate

      Source |       SS       df       MS              Number of obs =      20
-------------+------------------------------           F(  4,    15) =    1.07
       Model |  1.6255e+14     4  4.0638e+13           Prob > F      =  0.4036
    Residual |  5.6740e+14    15  3.7826e+13           R-squared     =  0.2227
-------------+------------------------------           Adj R-squared =  0.0154
       Total |  7.2995e+14    19  3.8418e+13           Root MSE      =  6.2e+06

------------------------------------------------------------------------------
households~y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        fdi |  -.0002055   .0003045    -0.67   0.510    -.0008546    .0004436
        pop |     3027.9   2807.229     1.08   0.298    -2955.567    9011.368
       cgdp |  -10356.61    7177.07    -1.44   0.170    -25654.18    4940.948
    litrate |  -1.03e+07   1.25e+07    -0.83   0.421    -3.70e+07    1.63e+07
```

```
       _cons |   5.05e+08   6.17e+08     0.82   0.426    -8.11e+08    1.82e+09
------------------------------------------------------------------------------

. reg   richand40pooravgration fdi pop cgdp litrate

      Source |       SS       df       MS              Number of obs =      20
-------------+------------------------------           F(  4,    15) =    7.37
       Model |  55.8142071     4  13.9535518           Prob > F      =  0.0017
    Residual |  28.3900298    15  1.89266866           R-squared     =  0.6628
-------------+------------------------------           Adj R-squared =  0.5729
       Total |   84.204237    19  4.43180195           Root MSE      =  1.3757

------------------------------------------------------------------------------
richand40p~n |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         fdi |  -6.05e-11   6.81e-11    -0.89   0.388    -2.06e-10    8.47e-11
         pop |  -.0005574   .0006279    -0.89   0.389    -.0018958     .000781
        cgdp |   .0038559   .0016054     2.40   0.030     .0004341    .0072778
     litrate |   1.975972   2.796516     0.71   0.491    -3.984661    7.936606
       _cons |  -79.48459   138.0512    -0.58   0.573    -373.7338    214.7646
------------------------------------------------------------------------------

. reg  gini fdi pop cgdp agremp indusemp servemp

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  6,    11) =    2.49
       Model |  .001898623     6  .000316437           Prob > F      =  0.0898
    Residual |  .001395825    11  .000126893           R-squared     =  0.5763
```

```
-------------+------------------------------           Adj R-squared =  0.3452
       Total |  .003294447    17  .000193791           Root MSE      =  .01126

------------------------------------------------------------------------------
        gini |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         fdi |  -3.64e-13   4.82e-13    -0.76   0.466    -1.42e-12    6.96e-13
         pop |  -1.52e-06   1.33e-06    -1.14   0.277    -4.44e-06    1.41e-06
        cgdp |    .000013    .000017     0.76   0.460    -.0000244    .0000505
     agremp |   .0103609   .0503639     0.21   0.841    -.1004892     .121211
   indusemp |   .0127197   .0491388     0.26   0.801     -.095434    .1208734
    servemp |   .0160008   .0528626     0.30   0.768    -.1003489    .1323505
       _cons |   -.624844    5.06888    -0.12   0.904    -11.78137    10.53168
------------------------------------------------------------------------------

. reg theil  pop cgdp agremp indusemp servemp litrate

      Source |       SS       df       MS              Number of obs =      17
-------------+------------------------------           F(  6,    10) =    2.02
       Model |  .019677265     6  .003279544           Prob > F      =  0.1553
    Residual |  .016220263    10  .001622026           R-squared     =  0.5482
-------------+------------------------------           Adj R-squared =  0.2770
       Total |  .035897529    16  .002243596           Root MSE      =  .04027

------------------------------------------------------------------------------
       theil |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         pop |  -.0000236   .0000355    -0.66   0.522    -.0001026    .0000555
```

```
       cgdp |   .0000657   .0000692     0.95   0.365    -.0000884    .0002198
      agremp |   .0509365   .2364674     0.22   0.834    -.4759456    .5778187
    indusemp |   .0625568   .2286737     0.27   0.790    -.4469599    .5720735
     servemp |   .0621723   .2432377     0.26   0.803    -.4797952    .6041397
     litrate |   .0897224   .1791875     0.50   0.627    -.3095322     .488977
       _cons |  -9.364199    24.0471    -0.39   0.705    -62.94448    44.21608
------------------------------------------------------------------------------

. reg  theil lnfdi lnpop lncgdp litrate

      Source |       SS       df       MS              Number of obs =      21
-------------+------------------------------           F(  4,    16) =    0.71
       Model |  .011795011     4  .002948753           Prob > F      =  0.5939
    Residual |  .066006132    16  .004125383           R-squared     =  0.1516
-------------+------------------------------           Adj R-squared = -0.0605
       Total |  .077801144    20  .003890057           Root MSE      =  .06423

------------------------------------------------------------------------------
       theil |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       lnfdi |  -.0114434   .0224601    -0.51   0.617    -.0590566    .0361698
       lnpop |   4.317923   6.968278     0.62   0.544    -10.45417    19.09001
      lncgdp |  -.3855017   .3527371    -1.09   0.291    -1.133271    .3622676
     litrate |   -.115833   .2132371    -0.54   0.594    -.5678755    .3362094
       _cons |  -37.65722   63.75757    -0.59   0.563    -172.8172     97.5028
------------------------------------------------------------------------------

. reg  gini lnfdi lnpop lncgdp litrate
```

```
      Source |       SS       df       MS              Number of obs =      21
-------------+------------------------------           F(  4,    16) =    0.49
       Model |  .000509432     4  .000127358           Prob > F      =  0.7422
    Residual |  .004147714    16  .000259232           R-squared     =  0.1094
-------------+------------------------------           Adj R-squared = -0.1133
       Total |  .004657146    20  .000232857           Root MSE      =   .0161

------------------------------------------------------------------------------
        gini |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       lnfdi |   .0010699   .0056302     0.19   0.852    -.0108656    .0130054
       lnpop |   2.036116   1.746778     1.17   0.261    -1.666888    5.739121
      lncgdp |   -.077934   .0884226    -0.88   0.391    -.2653816    .1095136
     litrate |  -.0618815   .0534534    -1.16   0.264    -.1751976    .0514345
       _cons |  -17.94926   15.98247    -1.12   0.278    -51.83059    15.93207
------------------------------------------------------------------------------

. reg  gini  fdi  unemp pop cgdp

      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  4,    13) =    2.77
       Model |  .001514939     4  .000378735           Prob > F      =  0.0728
    Residual |  .001779508    13  .000136885           R-squared     =  0.4598
-------------+------------------------------           Adj R-squared =  0.2936
       Total |  .003294447    17  .000193791           Root MSE      =   .0117

------------------------------------------------------------------------------
```

```
        gini |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         fdi |   4.84e-13   6.18e-13     0.78   0.447    -8.51e-13    1.82e-12
       unemp |  -.0073725   .0057427    -1.28   0.222    -.0197789    .0050339
         pop |   1.30e-07   2.09e-06     0.06   0.951    -4.39e-06    4.65e-06
        cgdp |   9.38e-06   .0000247     0.38   0.710    -.0000439    .0000627
       _cons |      .5634   .1534101     3.67   0.003     .2319777    .8948224
------------------------------------------------------------------------------

. save "E:\Thesis\Int Econ\Apr11Reg.dta"
file E:\Thesis\Int Econ\Apr11Reg.dta saved

. exit, clear
```

C. DEVELOPMENT ECONOMICS STATA LOG FILES

```
-------------------------------------------------------------------------------
      log:  C:\Documents and Settings\gtg991g\Desktop\devregapr17.smcl
  log type:  smcl
 opened on:  17 Apr 2007, 22:17:49

. giniindex landreform landusearablelandoflandarea landuseirrigatedlandofcropland
urbanpopulation
> oftotal ruralpopulationoftotalpopulation agriculturevalueaddedperworkerco
unrecognized command:  giniindex
r(199);

. reg  giniindex landreform pop landusearablelandoflandarea
landuseirrigatedlandofcropland urbanpo
> pulationoftotal ruralpopulationoftotalpopulation agriculturevalueaddedperworkerco

      Source |       SS       df       MS              Number of obs =      22
-------------+------------------------------           F(  7,    14) =    3.14
       Model |  .002846795     7  .000406685            Prob > F      =  0.0325
    Residual |  .001812299    14   .00012945            R-squared     =  0.6110
-------------+------------------------------           Adj R-squared =  0.4165
       Total |  .004659094    21  .000221862            Root MSE      =  .01138

------------------------------------------------------------------------------
   giniindex |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  landreform |  -.0007687   .0136255    -0.06   0.956    -.0299924     .028455
         pop |   .0000116   6.76e-06     1.72   0.108    -2.90e-06    .0000261
landuseara~a |   .0953384   .0393367     2.42   0.030     .0109695    .1797072
landuseirr~d |   .0816314   .0239559     3.41   0.004      .030251    .1330117
urbanpop~tal |  -.7801611   1.380851    -0.56   0.581    -3.741792     2.18147
ruralpopul~n |  -.7153859   1.392073    -0.51   0.615    -3.701085    2.270313
agricultur~o |   .0000273   .0000216     1.27   0.226     -.000019    .0000736
       _cons |   74.20846   138.8815     0.53   0.601    -223.6627    372.0796
------------------------------------------------------------------------------

. reg   theilindex landreform pop landusearablelandoflandarea
landuseirrigatedlandofcropland urban
> populationoftotal ruralpopulationoftotalpopulation agriculturevalueaddedperworkerco

      Source |       SS       df       MS              Number of obs =      22
-------------+------------------------------           F(  7,    14) =    3.96
       Model |  .051211487     7  .007315927            Prob > F      =  0.0137
    Residual |  .025883967    14  .001848855            R-squared     =  0.6643
```

```
-------------+------------------------------           Adj R-squared =  0.4964
       Total |  .077095454    21  .003671212           Root MSE      =    .043

------------------------------------------------------------------------------
  theilindex |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  landreform |  -.0353716   .0514934    -0.69   0.503    -.1458139    .0750708
         pop |   .0000715   .0000256     2.80   0.014     .0000167    .0001263
landuseara~a |   .2690103   .1486614     1.81   0.092    -.0498368    .5878574
landuseirr~d |   .2646926   .0905344     2.92   0.011     .0705156    .4588695
urbanpop~tal |  -1.001459    5.21852    -0.19   0.851    -12.19407    10.19115
ruralpopul~n |   -.681761   5.260929    -0.13   0.899    -11.96533    10.60181
agricultur~o |   .0000519   .0000816     0.64   0.535    -.0001231    .0002268
       _cons |   79.06723   524.8616     0.15   0.882    -1046.649    1204.783
------------------------------------------------------------------------------

. edit
- preserve

. reg  giniindex landreform pop  landuseirrigatedlandofcropland urbanpopulationoftotal
ruralpopula
> tionoftotalpopulation agriculturevalueaddedperworkerco

      Source |       SS       df       MS              Number of obs =      22
-------------+------------------------------           F(  6,    15) =    2.03
       Model |  .002086396     6  .000347733           Prob > F      =  0.1251
    Residual |  .002572698    15  .000171513           R-squared     =  0.4478
-------------+------------------------------           Adj R-squared =  0.2269
       Total |  .004659094    21  .000221862           Root MSE      =   .0131

------------------------------------------------------------------------------
   giniindex |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  landreform |  -.0075937   .0153451    -0.49   0.628     -.040301    .0251136
         pop |   .0000135   7.74e-06     1.74   0.102    -3.00e-06      .00003
landuseirr~d |   .0328119    .014926     2.20   0.044     .0009979    .0646259
urbanpop~tal |  -1.348937    1.56632    -0.86   0.403    -4.687469    1.989594
ruralpopul~n |  -1.295834   1.578467    -0.82   0.425    -4.660257     2.06859
agricultur~o |   .0000107   .0000236     0.45   0.657    -.0000395    .0000609
       _cons |   131.9404    157.492     0.84   0.415    -203.7458    467.6266
------------------------------------------------------------------------------

. reg  giniindex landreform  landuseirrigatedlandofcropland urbanpopulationoftotal
ruralpopulation
> oftotalpopulation agriculturevalueaddedperworkerco
```

```
      Source |       SS       df       MS              Number of obs =      22
-------------+------------------------------           F(  5,    16) =    1.62
       Model |  .001565116     5  .000313023           Prob > F      =  0.2117
    Residual |  .003093978    16  .000193374           R-squared     =  0.3359
-------------+------------------------------           Adj R-squared =  0.1284
       Total |  .004659094    21  .000221862           Root MSE      =  .01391

------------------------------------------------------------------------------
  giniindex |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
------------+-----------------------------------------------------------------
 landreform |  -.0027165   .0160206    -0.17   0.867    -.0366788    .0312457
landuseirr~d |   .0232256    .014734     1.58   0.135    -.0080091    .0544603
urbanpop~tal |  -2.660889   1.458613    -1.82   0.087     -5.75301    .4312323
ruralpopul~n |  -2.651942   1.458396    -1.82   0.088    -5.743604    .4397194
agricultur~o |   .0000371   .0000191     1.94   0.071    -3.51e-06    .0000777
       _cons |   266.2492   145.8542     1.83   0.087    -42.94783    575.4462
------------------------------------------------------------------------------

. reg  giniindex landreform  landuseirrigatedlandofcropland
ruralpopulationoftotalpopulation agric
> ulturevalueaddedperworkerco

      Source |       SS       df       MS              Number of obs =      22
-------------+------------------------------           F(  4,    17) =    1.05
       Model |  .000921583     4  .000230396           Prob > F      =  0.4118
    Residual |  .003737511    17  .000219854           R-squared     =  0.1978
-------------+------------------------------           Adj R-squared =  0.0091
       Total |  .004659094    21  .000221862           Root MSE      =  .01483

------------------------------------------------------------------------------
  giniindex |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
------------+-----------------------------------------------------------------
 landreform |  -.0014065   .0170652    -0.08   0.935    -.0374109     .034598
landuseirr~d |   .0239372    .015705     1.52   0.146    -.0091974    .0570717
ruralpopul~n |   .0085408   .0043594     1.96   0.067    -.0006568    .0177384
agricultur~o |   .0000349   .0000204     1.71   0.105    -8.10e-06    .0000779
       _cons |   .1735593   .2208149     0.79   0.443    -.2923193     .639438
------------------------------------------------------------------------------

. reg  giniindex landreform  landuseirrigatedlandofcropland urbanpopulationoftotal
agricultureval
> ueaddedperworkerco

      Source |       SS       df       MS              Number of obs =      22
-------------+------------------------------           F(  4,    17) =    1.05
       Model |  .000925713     4  .000231428           Prob > F      =  0.4091
```

```
   Residual |  .003733381    17  .000219611           R-squared     =  0.1987
------------+----------------------------           Adj R-squared =  0.0101
      Total |  .004659094    21  .000221862           Root MSE      =  .01482

------------------------------------------------------------------------------
  giniindex |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
------------+-----------------------------------------------------------------
 landreform |  -.0014014   .0170555    -0.08   0.935    -.0373854    .0345826
landuseirr~d |   .0239962   .0156953     1.53   0.145    -.0091179    .0571104
urbanpop~tal |  -.0085629   .0043577    -1.97   0.066    -.0177568     .000631
agricultur~o |    .000035   .0000204     1.72   0.104    -7.99e-06     .000078
       _cons |   1.028757   .2166401     4.75   0.000     .5716862    1.485828
------------------------------------------------------------------------------

. reg  giniindex landreform  landuseirrigatedlandofcropland urbanpopulationoftotal
ruralpopulation
> oftotalpopulation

      Source |       SS       df       MS              Number of obs =      22
-------------+------------------------------           F(  4,    17) =    0.93
       Model |  .000839934     4  .000209983           Prob > F      =  0.4674
    Residual |   .00381916    17  .000224656           R-squared     =  0.1803
-------------+------------------------------           Adj R-squared = -0.0126
       Total |  .004659094    21  .000221862           Root MSE      =  .01499

------------------------------------------------------------------------------
  giniindex |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
------------+-----------------------------------------------------------------
 landreform |   .0084955   .0161009     0.53   0.605    -.0254744    .0424653
landuseirr~d |   .0106578   .0142576     0.75   0.465    -.0194231    .0407388
urbanpop~tal |  -2.483892   1.569086    -1.58   0.132    -5.794373    .8265889
ruralpopul~n |  -2.481712   1.569083    -1.58   0.132    -5.792188    .8287646
       _cons |   248.8894   156.9126     1.59   0.131    -82.1673     579.946
------------------------------------------------------------------------------

. reg  giniindex landreform

      Source |       SS       df       MS              Number of obs =      22
-------------+------------------------------           F(  1,    20) =    0.32
       Model |  .000073208     1  .000073208           Prob > F      =  0.5783
    Residual |  .004585886    20  .000229294           R-squared     =  0.0157
-------------+------------------------------           Adj R-squared = -0.0335
       Total |  .004659094    21  .000221862           Root MSE      =  .01514

------------------------------------------------------------------------------
  giniindex |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
```

```
-------------+----------------------------------------------------------------
 landreform |  -.0043529   .0077037    -0.57   0.578    -.0204225    .0117167
      _cons |   .6023529   .0036726   164.01   0.000     .5946921    .6100138
------------------------------------------------------------------------------

. reg  theilindex landreform

      Source |       SS       df       MS              Number of obs =      22
-------------+------------------------------           F(  1,    20) =    0.88
       Model |  .003262512     1  .003262512           Prob > F      =  0.3584
    Residual |  .073832942    20  .003691647           R-squared     =  0.0423
-------------+------------------------------           Adj R-squared = -0.0056
       Total |  .077095454    21  .003671212           Root MSE      =  .06076

------------------------------------------------------------------------------
  theilindex |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 landreform |  -.0290588   .0309109    -0.94   0.358    -.0935379    .0354202
      _cons |   .7570588   .0147362    51.37   0.000     .7263196     .787798
------------------------------------------------------------------------------

. reg  theilindex landreform pop

      Source |       SS       df       MS              Number of obs =      22
-------------+------------------------------           F(  2,    19) =    0.83
       Model |  .006166088     2  .003083044           Prob > F      =  0.4530
    Residual |  .070929366    19  .003733125           R-squared     =  0.0800
-------------+------------------------------           Adj R-squared = -0.0169
       Total |  .077095454    21  .003671212           Root MSE      =   .0611

------------------------------------------------------------------------------
  theilindex |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 landreform |  -.0002188   .0451176    -0.00   0.996     -.094651    .0942134
        pop |  -8.39e-07   9.51e-07    -0.88   0.389    -2.83e-06    1.15e-06
      _cons |   .8719788   .1311462     6.65   0.000     .5974867    1.146471
------------------------------------------------------------------------------

. reg  theilindex landreform landuseirrigatedlandofcropland

      Source |       SS       df       MS              Number of obs =      22
-------------+------------------------------           F(  2,    19) =    0.73
       Model |   .00552277     2  .002761385           Prob > F      =  0.4935
    Residual |  .071572684    19  .003766983           R-squared     =  0.0716
-------------+------------------------------           Adj R-squared = -0.0261
       Total |  .077095454    21  .003671212           Root MSE      =  .06138
```

```
------------------------------------------------------------------------------
  theilindex |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  landreform |  -.0199043   .0333864    -0.60   0.558    -.0897829    .0499743
landuseirr~d |  -.0157262   .0203021    -0.77   0.448    -.0582189    .0267666
       _cons |   .8154954   .0768948    10.61   0.000     .6545528     .976438
------------------------------------------------------------------------------

. reg giniindex landreform landuseirrigatedlandofcropland

      Source |       SS       df       MS              Number of obs =      22
-------------+------------------------------           F(  2,    19) =    0.16
       Model |  .000076346     2  .000038173           Prob > F      =  0.8547
    Residual |  .004582748    19  .000241197           R-squared     =  0.0164
-------------+------------------------------           Adj R-squared = -0.0872
       Total |  .004659094    21  .000221862           Root MSE      =  .01553

------------------------------------------------------------------------------
   giniindex |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  landreform |  -.0040118   .0084481    -0.47   0.640    -.0216939    .0136703
landuseirr~d |   -.000586   .0051372    -0.11   0.910    -.0113383    .0101664
       _cons |   .6045303   .0194575    31.07   0.000     .5638054    .6452552
------------------------------------------------------------------------------

. reg  giniindex landreform  ruralpopulationgrowthannual

      Source |       SS       df       MS              Number of obs =      22
-------------+------------------------------           F(  2,    19) =    0.20
       Model |  .000094609     2  .000047305           Prob > F      =  0.8229
    Residual |  .004564485    19  .000240236           R-squared     =  0.0203
-------------+------------------------------           Adj R-squared = -0.0828
       Total |  .004659094    21  .000221862           Root MSE      =   .0155

------------------------------------------------------------------------------
   giniindex |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  landreform |   -.006581   .0108585    -0.61   0.552    -.0293081    .0161461
ruralpopul~l |  -.0026249   .0087947    -0.30   0.769    -.0210324    .0157825
       _cons |   .6003024   .0078314    76.65   0.000     .5839111    .6166938
------------------------------------------------------------------------------

. reg  giniindex urbanpopulationgrowthannual

      Source |       SS       df       MS              Number of obs =      22
```

```
-------------+------------------------------           F(  1,    20) =    0.50
       Model |  .000112959     1  .000112959           Prob > F      =  0.4890
    Residual |  .004546134    20  .000227307           R-squared     =  0.0242
-------------+------------------------------           Adj R-squared = -0.0245
       Total |  .004659094    21  .000221862           Root MSE      =  .01508

------------------------------------------------------------------------------
  giniindex |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
urbanpop~ual |    .003433   .0048698     0.70   0.489    -.0067253    .0135912
       _cons |   .5913972   .0144988    40.79   0.000     .5611532    .6216411
------------------------------------------------------------------------------

. reg  giniindex landreform  landuseirrigatedlandofcropland
urbanpopulationgrowthannual agricultu
> revalueaddedperworkerco

      Source |       SS       df       MS              Number of obs =      22
-------------+------------------------------           F(  4,    17) =    0.44
       Model |  .000439901     4  .000109975           Prob > F      =  0.7758
    Residual |  .004219193    17  .000248188           R-squared     =  0.0944
-------------+------------------------------           Adj R-squared = -0.1187
       Total |  .004659094    21  .000221862           Root MSE      =  .01575

------------------------------------------------------------------------------
  giniindex |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
 landreform |  -.0031596   .0180934    -0.17   0.863    -.0413333    .0350141
landuseirr~d |   .0099115   .0133114     0.74   0.467    -.0181731    .0379961
urbanpop~ual |   .0310817   .0257299     1.21   0.244    -.0232037    .0853671
agricultur~o |   .0000148   .0000162     0.92   0.372    -.0000193    .0000489
       _cons |   .4298413   .1460366     2.94   0.009     .121731    .7379516
------------------------------------------------------------------------------

.  giniindex year
unrecognized command:  giniindex
r(199);

. reg  giniindex year

      Source |       SS       df       MS              Number of obs =      22
-------------+------------------------------           F(  1,    20) =    0.44
       Model |  .000100739     1  .000100739           Prob > F      =  0.5138
    Residual |  .004558354    20  .000227918           R-squared     =  0.0216
-------------+------------------------------           Adj R-squared = -0.0273
       Total |  .004659094    21  .000221862           Root MSE      =   .0151
```

```
------------------------------------------------------------------------------
  giniindex |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
------------+-----------------------------------------------------------------
       year |  -.0002878   .0004329    -0.66   0.514    -.0011909    .0006153
      _cons |   1.173566   .8606799     1.36   0.188    -.6217811    2.968913
------------------------------------------------------------------------------

.  giniindex urbanpopulationoftotal
unrecognized command:  giniindex
r(199);

. reg  giniindex urbanpopulationgrowthannual

      Source |       SS       df       MS              Number of obs =      22
-------------+------------------------------           F(  1,    20) =    0.50
       Model |  .000112959     1  .000112959           Prob > F      =  0.4890
    Residual |  .004546134    20  .000227307           R-squared     =  0.0242
-------------+------------------------------           Adj R-squared = -0.0245
       Total |  .004659094    21  .000221862           Root MSE      =  .01508

------------------------------------------------------------------------------
  giniindex |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
------------+-----------------------------------------------------------------
urbanpop~ual |    .003433   .0048698     0.70   0.489    -.0067253    .0135912
      _cons |   .5913972   .0144988    40.79   0.000     .5611532    .6216411
------------------------------------------------------------------------------

. save "E:\Thesis\Dev Econ\devregapr17.dta"
file E:\Thesis\Dev Econ\devregapr17.dta saved

. exit, clear
```

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